BELLCOMM, INC.

SUBJECT: Comparison of Payload Capability of the Uprated Saturn I with Orbits of Unmanned Satellites, Case 600-1

DATE: September 12, 1967

FROM: T. C. Tweedie, Jr.

ABSTRACT

The capability of the Uprated Saturn I plus a manned spacecraft to achieve orbits identical to those of planned unmanned satellites is examined. It is shown that the orbital requirements of the majority of unmanned satellites cannot be accomodated by an Uprated Saturn I which also carries a manned CSM.

(NASA-CR-54727) COMPARISON OF PAYLOAD CAPABILITY OF THE UPRATED SATURN I WITH ORBITS OF UNMANNED SATELLITES (Bellcomm, Inc.) 7 p

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MEMORANDUM FOR FILE

Diverse scientific and technological objectives in space are planned through a program of unmanned satellites, launched into various orbital altitudes and inclinations; each orbit peculiar to the payload and objective of the mission. Assuming that the orbital parameters of the unmanned satellites are determined by their scientific payloads and hence cannot be changed, the capability of the Uprated Saturn I launch vehicle plus a manned spacecraft to achieve identical orbits is examined.

Table I lists the unmanned earth orbiting satellites scheduled, plus the planned orbit for each satellite. Figure 1 shows the location of the unmanned satellites on a plot of orbital altitude vs. inclination. Isopayload lines illustrating the capability of the Uprated Saturn I launch vehicle are also shown. Since the payload to orbit is dependent on the launch mode (e.g. direct injection, Hohman transfer from a parking orbit) one scheme was selected for representation. The Uprated Saturn I launches into an 80 nm circular earth orbit a CSM plus a payload carried in the SLA. In this orbit the CSM transposes and docks to the payload. The CSM plus SLA payload (the weights labled on the curves) is then injected into the final higher circular orbit by the service module propulsion system. To achieve orbital inclinations higher than 28.5°, the launch azimuth from Cape Kennedy is raised; to achieve orbital inclinations less than 28.5° a plane change is made at the final altitude.

The radiation zone, shown extending from 350 nm to 15,000 nm, is a gross approximation included for illustrative purposes. The inner zone of trapped radiation is present at altitudes below 350 nm but is of such magnitude that manned space-flight is possible for extended duration. The magnitude of the radiation at high altitudes has not yet been fully measured and hence is still subject to wide uncertainty.

From Figure 1 it can be seen that the orbital requirements of the majority of unmanned satellites cannot be accomodated by an Uprated Saturn I which also carries a manned CSM.

T. C. Tweedie Jr.

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T. C. Tweedie, Jr.

TABLE I*

Spacecraft	Inclination (degrees)	Apogee (nm)	Perigee (nm)
Orbiting Solar Observatory			
OSO-D and F through H	33	300	300
Orbiting Geophysical Observatory			
OGO-D (POGO)	84	500	200
OGO-E (EGO)	31	80,000	150
OGO-F (POGO)	86	600	200
Orbiting Astronomical Observatory			
OAO-A2 (P)	35	430	430
OAO-B	35	430	430
OAO-C	35	430	430
Small Scientific Satellite			
SSS - A	37	17,000	200
International Satellites for Ionospheric Studies			
ISIS-A	83	1,890	270
B	75	1,700	920
Small Astronomy Satellite			
SAS-A	3	300	300
Radio Astronomy Explorer RAE-A, B	58**	3,200	3,200
Air Density/Injun Explorers AD/I-C	90	1,600	350
University Explorers OWL-A, B	80	350	350
Biosatellite			
B	33.5	170	170
C, D, E, F	33.5	200	200
Applications Technology Satellites			
ATS-C	Equatorial	19,340	Geostationary
ATS-D, E	Equatorial	19,340	Geostationary

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*This table is based on data obtained from the July 1967 edition of NASA Pocket Statistics, For Official Use Only.

**Retrograde Orbit

TABLE I (CONT.)

Spacecraft	Inclination (degrees)	Apogee (nm)	Perigee (nm)
Geodetic Explorer GEOS-B	74**	800	600
Nimbus B D	80**	600	600
Tiros M	80**	770	770
Tiros Operational Satellite** TOS-G TOS-D, F, H, P-1 (APT) TOS-I through M (Improved TOS)	80**	770	770

**Retrograde Orbit

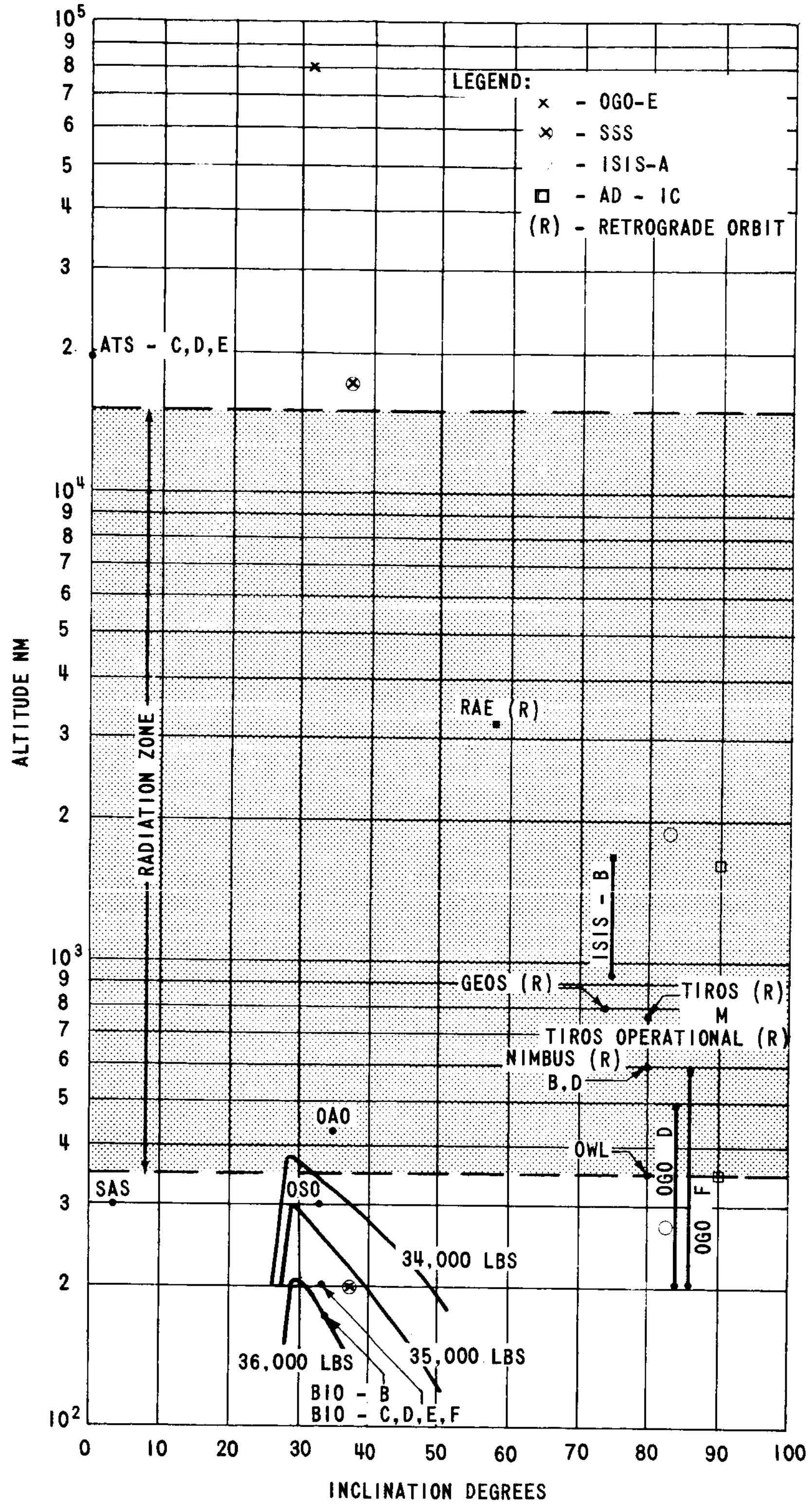

FIGURE I - ORBITS OF UNMANNED SATELLITES AND UPRATED SATURN I CAPABILITY OF THE (CSM + SLA PAYLOAD, HOHMAN FROM 80 NM USING SPS PROPULSION)

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